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to try anxiously to find access to the honey of several flowers, but in every case it tried to enter at the side of the wings, and always failed. One large butterfly was seen to insert its proboscis at the side of the wings, and as it remained quietly standing for some time it probably obtained nectar. Several small butterflies alighted on the vexillum and ran their proboscides down the guiding groove, but necessarily failed to fertilize the flowers as they exerted no pressure on the keel. Many humble bees were seen to enter the flowers. Catching their anterior tarsi on the sides of the standard, they pulled themselves between this and the keel by sheer force, and then relaxing their hold, they protruded their tongues and feasted upon the nectar. In every case they caused the stigma and anthers to be exserted, and these always came in contact with their backs. Where flowers had been visited many times by these bees the sides of the vexillum, and especially near its base, were greatly scratched, and in some cases cut through by their sharp tarsal claws. When the bee left the flower the keel invariably returned to its former position so as to enclose the organs of fertilization. Hive bees were also seen to visit flowers of this species several times, and they acted precisely as the humble bees did, and with a similar result.

Quite a number of flowers were seen with large perforations (Fig. VIII) through both wing and keel, just back of the position commonly occupied by the anthers and stigma. As these did not allow access to the nectar, but did expose the pollen, I am inclined to think that they were made by some pollen-collecting insect—probably humble bees—though I was unable to see the openings made or used by any insect. In Alabama, where these observations were made, the flowers of this plant are largely fertile, but it was not determined whether they are self-fertile or not.

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RECENT LITERATURE.

CLARK'S ANATOMY AND PHYSIOLOGY OF THE LUCERNARIÆ.[1]—American zoölogical science has, from the beginning, been especially lacking in histological investigations. The lamented author of the beautiful memoir before us, did far more than any one else to remove this reproach upon American biology. He was admirably adapted by nature for doing histological work, being cautious, careful, thorough and honest, and skillful in the technical and mechanical part of the work. But the present memoir, as well as many of Clark's other writings, evinces a thoughtfulness and grasp of the subject which characterizes observers of a high order, though he failed at times to record his observations in a style as terse and simple as that of some other writers.

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[1] *Lucernariæ and their Allies.* A memoir on the anatomy and physiology of *Haliclystus auricula* and other Lucernarians, with a discussion of their relations to other Acalephæ, to Beroids and Polypi. By HENRY JAMES CLARK, B.S., A.B. Smithsonian Contributions to Knowledge. Washington, September, 1878. 4to, pp. 130, 11 plates.

Though this monograph bears as its date of publication, September, 1878, five years after the author's death, we received it in July of the present year. If we are to judge by the quality of the memoir, it is the most important zoölogical work (because involving so much hard labor and done with so much care) which has appeared in this country for several years, and we say this without disparagement to others.

The Lucernaria is a creature, not often met with, living attached by its tail or peduncle to eel grass or sea weeds just beyond low-water mark. The differences of opinion regarding its true position in nature, whether to be reckoned a jelly-fish or a type of a distinct order, led the author, who had paid so much attention to the Polyps and Acalephs, to devote time extending over several years to the full elaboration of its general and minute anatomy, its mode of development and relations to neighboring types of life. This has led to the preparation of an elaborate monograph, most carefully prepared, and illustrated by drawings which are not inferior in faithfulness, finish and artistic effect to those of any American, and few European delineators of the invertebrate animals. The text is divided into seven chapters; in the first, on individuality, the author discusses the subject of animal individuality, illustrating his points by reference mainly to the polyps and acalephs. The subject is sufficiently simple when the vertebrates are involved, but among the polyps, jelly-fishes, Polyzoa and Ascidians, where many forms are social, compound and often many-headed, it is difficult to say where the organ ends and the individual begins. The author clearly distinguishes between organs like those of the Tubularians and Siphonophores which have a high degree of individuality, and the individual joints (proglottides) of the tape worms; and does not fall into the error of regarding the former as truly individuals. The sexual and sexless organs of the polycephalic Acalephs, such as the Tubularians, "are necessary to make up a complete organism, *i. e.*, vegetative and reproductive, the one a complement of the other, neither *alone* can represent the *individual* unit, or whole cycle of life." We infer from the statement made that Clark regarded the so-called polymorphic individuals as "organs under various disguises;" a view which seems to us most reasonable. Clark ascribes a high degree of individuality to the jelly-fish, Pelagia, and only a less amount to Lucernaria.

The author in a third chapter attempts to point out an antero-posterior repetition of parts in the strobila of the Acalephs. In the fourth and fifth chapters a detailed account of the anatomy and physiology of Lucernaria is given. A number of new terms are adopted; among them *opsophragma* for the face-wall of Lucernaria, and *ectophragma* for the wall of the posterior face; *opsomyoplax* for the stratum of muscular substance immediately subtending the opsophragma. The bulk of the solid material of the body or musculo-gelatiniform layer is called the *chondromyoplax* (this is probably the mesoderm of recent writers); the gelatiniform layer is designated as the *chondrophys.* Particular attention is paid to the taxonomy of the tentacles, so characteristic a feature of these animals; and the fine structure of the marginal adhesive bodies (Colletocystophores) or anchors, is elaborated, and these bodies judged to be modified tentacles; certain other bodies (digituli) are carefully discussed and compared with similar bodies in the Acalephs. The digestive, nervous and reproductive systems are described, and then follows Chapter VI on embryology, comprising a description of the smallest specimen of *Halyclystus auricula* yet met with, which was one-sixteenth of an inch in diameter; but the development within the egg is not given. In the chapter on histology a discussion as to the nature of cells is introduced in a lengthy foot-note. Clark believed with other advanced histologists that "*cells* so called (no matter whether constituted according to the older histologists or according to the most recent theory), are, after all, of secondary importance, and that the *cytoblastema* (which we do not distinguish from intercellular substance) is in the main an *essential element*, the potential progenitor of all tissues, and that it projects itself into the utmost future of the living body by a process of self-proliferation." This cytoblastema, as Schwann (not Schwa*m*, as printed in this memoir) called it, corresponds to the sarcode of Dujardin or protoplasm of recent authors, as he remarks incidentally that "all Rhizopods are moving, sentient masses of *Cytoblastema*, and that alone."

It is now generally believed, and has especially been insisted on by Hæckel that cilia are prolongations or extensions of the protoplasmic substance of the cells from which they arise. This discovery was first made by Clark and published by him as early as 1863. He then stated that "all vibratile cilia originate in the amorphous intercellular substance."[1] He then adds in the present memoir, which was written in 1869 and 1870, judging by the context: "This has particular reference to those cilia that cover cells which are fully developed, and have a distinct cell-membrane. It would be true, as a matter of course, in the opinion of those who hold that Infusoria are composed of *sarcode*, but

[1] See Proceedings of the Boston Society of Natural History, September, 1863, p. 283; and Annals and Magazine of Natural History, December, 1864.

apparently untenable if we admit with Kölliker, which we do not, that they are unicellular, while we deny that these cilia are direct prolongations of the cells which they seem to be so closely related to, we do not assert that they are always disconnected with some form of cell in the modern acceptance of the ideal cell. We do, however, believe that they are never the filiform proliferations of a distinct cell-membrane, however much they may appear to be so, but that in such cases they arise from the cytoblastema which overlies the cells."

That vibratile cilia are "individualistic in their movements at times, just as an arm or a leg is individualized" is claimed by our author, who remarks as follows: "Cilia are commonly treated of like masses of men in an army, all moving to one determined end, as if the recorder of their movements did not think that the animal possessing them had the discriminating power of controlling the actions of any one separately. As well might one claim that the numerous legs of a centipede are not capable of individual control." The beautiful figure given indicates the individuality of the cilia, and that they are "individually controllable."

The memoir ends abruptly with an account of the lasso cells or préhensile cysts (nematocysts and colletocysts), by which, as in most other Cœlenterates, the prey is benumbed and thus rendered more easy of capture. In 1863 Clark published the opinion that the nematocysts "have an intercellular origin, and do not develop within the cells which form the layer in which they are imbedded, but commence their career, *de novo*, by free-cell formation in the cytoblastema." the latter term referring, as we understand it, to the protoplasm or parenchym of the body. Description is also given of certain "tactile bristles," which he describes as "standing sentinel at the doors of the nematocysts to give warning of the approach of any foreign body."

The *Lucernariæ* were regarded by Clark as not being truly radiate animals, but as in a degree bilateral, with a fore and hinder end. The commonly received theory that the so-called *Radiata* are founded upon the idea of radiation, was combatted by the author in 1865.[1] He gives the following reasons: "We assume that, as in all the other four grand divisions of animals, the mouth is at the cephalic or anterior extremity of the body, and that all the rest of the organism is virtually, if not really, topographically behind it, and that whatever extends from the oral end of the body *does not radiate* from that end in two, three, four or five or more directions, but trends posteriorly in so many lines parallel-wise to a longitudinal axis, and to a vertical sectant plane which divides the body into a bilateral figure. To give the idea a reality, we have but to point to the mouth of an Actinia as the cephalic end of our bilateral figure, and looking inwardly we shall see the flat stomach forming the sectant plane, which, extended in imagination in two opposite directions, would strike the periphery of the body along two dorsal and ventral lines one hundred and eighty degrees from each other, and then, projected still further away from the mouth, would terminate finally in the posterior, adherent discoid end. Parallel-wise with this plane all of the partitions of the digestive cavity trend, like a series of superposed shelves or galleries, in direct lines from the region lying right and left of the mouth, and of the flattened parallel sides of the stomach, backward along the inner face of the cylindrical periphery, so as to subdivide the included space into as many longitudinal corridors. It is these partitions which, by their multiplied sameness, constitute, among others, the elements that embody the dorso-ventrally repetitive type; the true ideal, as we firmly believe, upon which this grand division is founded.

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[1] Mind in Nature, or the Origin of Life and the Mode of Development of Animals. By H. J. Clark. D. Appleton & Co. 1865.

"We think we shall be understood now when we say that the multitudinous chymiferous canals of the disciform Æquorea and the quadruple channels of the cylindrical bell of Sarsia are two widely separated extremes of dorso-ventrally repetitive sameness; or that the numerous ambulacea of Solaster and the five of Asterias represent two extremes of dorso-ventral repetition, thrown forward, 'into rank,' to the same line with the mouth; whilst the retreating rows of Echinus, and the more differentiated ones of Spatangus and Schizaster, and the like, present the idea in a less disguised form, to be finally exemplified, in its fullest expression and clearness, in the elongated vermiform Holothuria."

The views, in these days, of the most eminent naturalists, coincides with those of Clark, that radiation is, on the whole, a superficial feature, not always constant in Cuvier's *Radiata*, though often well marked. The type has been dismembered, though the radial symmetry usually present in the members of the Cœlenterates and Echinoderms is paralleled by the articulated or segmented disposition of parts in the members of Cuvier's Articulata, and in a less apparent but true sense in the Vertebrates.

Complete and elaborate as it is so far as it extends, this beautiful memoir was evidently designed to cover at least fifteen parts, as reference is made to several chapters composing Part xv, only two parts having an actual existence. A broken shaft would represent both the author's life and this posthumous work, each symmetrical and thoroughly finished to the point where they suddenly broke off.

RECENT BOOKS AND PAMPHLETS.—Appunti Ittiologica sulle collezioni del Museo Civico di Genova. Per D. Vinciguerra. I. Enumerazione di alcune specie di pesci raccolti in Sumatra dal Dr. O. Beccari, 1879. (Ext. from Ann. del Mus. Civ. di Stor. Nat. di Genov., Vol. XIV, 10 Maggio, 9 Giugno, 1879.) 8vo, pp. 14. II. Intorno ai *Macrurus* del Golfo di Genova. (Tav. II.) (Ext. from the same journal, Vol. XIV, Agosto, 1879.) 8vo, pp. 19. From the author.